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## **EOSDIS Core System Project**

# **Flight Operations Segment (FOS) Release B Integration and Acceptance Test Procedures for the ECS Project**

October 1997

Hughes Information Technology Systems  
Upper Marlboro, Maryland

# **Flight Operations Segment (FOS) Release B Integration and Acceptance Test Procedures for the ECS Project**

**October 1997**

Prepared Under Contract NAS5-60000  
CDRL Items #055 and #070

## **APPROVED BY**

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# Preface

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This document defines the Flight Operations Segment (FOS) Integration and Acceptance Test Procedures for Release B. It covers CDRL item #055 (DID 322/DV3) and CDRL item #070 (DID 411/VE1), as deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract NAS5-60000.

This document is a contract deliverable with an approval code 2. As such, it does not require formal Government approval, however, the Government reserves the right to request changes within 45 days of the initial submittal. Once approved, contractor changes to this document are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan, and changes to this document shall be made by document change notice (DCN) or by complete revision.

Once approved, this document shall be under the ECS Configuration Control Board. Any questions or proposed changes should be addressed to:

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# Abstract

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The FOS Release B Integration and Acceptance Test Procedures document defines the set of test procedures that FOS will execute to verify its Level 3 and Level 4 requirements.

This document covers CDRL item #055 (DID 322/DV2) and CDRL item #070 (DID 411/VE1), as deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract NAS5-60000. This document specifies the FOS Test Procedures for Release B.

**Keywords:** I&T, RRR, CSR, Integration, NCR, FOS, Test, Requirements, Procedures, RBR, ECL, Threads

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## Abstract

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## **Abbreviations and Acronyms**

# **1. Introduction**

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## **1.1 Identification**

This document is the FOS Integration and Acceptance Test (AT) Procedures for the ECS Project, which are CDRL item #055 and #070 on the Contract Data Requirements List (CDRL) and defined by Data Item Description (DID 322/DV2 and DID 411/VE1) under contract NAS5-60000.

## **1.2 Scope**

This document defines the FOS integration and AT procedures for Release B. It focuses on delineating the approach that will be taken to incrementally integrate and test the FOS. In particular, the FOS Integration and Test Procedures for the ECS project details the approach for integrating and testing the FOS segment and verifying that the segment complies with the Release B requirements as specified in the Functional and Performance Requirements Specification (#423-41-02), as specified in the RTM database. This document is under the ECS Configuration Control Board (CCB) for the August 1996 draft submittal and the final release B submittal. Changes to these volumes must be approved by this CCB prior to inclusion in the document.

This document reflects the February 7, 1996, Technical Baseline maintained by the contractor configuration control board in accordance with ECS Technical Direction No. 11, dated December 6, 1994.

## **1.3 Purpose**

This document defines individual test case procedures for FOS Release B. It focuses on delineating the procedural steps necessary for the verification of all Release B Level 3 and Level 4 requirements. In addition, the document describes the responsible organizations that are involved in the FOS integration and test including their roles and responsibilities and schedules for testing during the Release B time period. It provides the program manager and test personnel with a systematic approach to verify that all of the Level 3 and Level 4 requirements mapped to the Release B Delivery have been satisfied by the integrated FOS subsystems.

## **1.4 Status and Schedule**

The submittal of DID 322/DV2 and DID 411/VE1 meets the milestone specified in CDRL of NASA contract NAS5-60000. This submittal is the final version of this document submitted at 30 days after RRR..

## 1.5 Deviations from the FOS Test Plan

The majority of deviations made from the test plan involve the reshaping of test cases (i.e. merging test cases, adding additional cases, deleting test cases and rescoping test cases). This was necessary due to the implementation of Configuration Change Requests (CCRs) affecting Level 4 requirements and Requirements by Release (RBRs), and a more mature understanding of the FOS functionality by the FOS Test Team. Additionally, associated requirement mapping matrices in appendices B, C, D, E (i.e. L4 Requirements to Test Case, Test Case to L4 Requirements, Release B RBRs to Test Case and Test Case to Release B RBRs) have been updated based on the RTM Baseline dated September 1997. Current requirement mappings delineated in these matrices coincide with the latest set of test procedures as defined in this document.

Minor revisions to the document were also made in the following areas:

- Section 3.6 (Test Data & Test Data Sources) has been updated to reflect the most current test data sources.
- Section 3.7 (Test Tools) has been updated to reflect the additional tools necessary to verify command and table load content.
- Section 3.8 has been updated to include the execution of a designed confidence test following emergency patch deliveries.
- Table 3-10.1 (The FOS Integration and Test Schedule) has been updated to reflect the latest Earth Science Data and Information System (ESDIS) and independent verification and validation (IV&V) test schedules.

## 1.6 Document Organization

This document is organized in the following manner:

Section 1.0 provides the scope and document organization.

Section 2.0 provides a list of applicable documents, which were used directly or indirectly in the preparation of this document.

Section 3.0 defines the FOS integration and test process. The section includes defining the responsible organizations involved in the FOS segment test; defining the approach to integrating and testing the FOS and supporting interfaces; identification of a reference to the schedule for performing integration and test of FOS functional components; identification of resources that are required for the system/segment test (i.e. FOS hardware, simulators, data drivers, instrument resources, etc.); and any software/hardware dependencies required for test execution.

Section 4.0 identifies the Release B infrastructure test cases and includes the following for each test case: test number, test title, applicable software/hardware test configuration, test support data items, test abstract, success criteria, and detailed test procedure steps.

Section 5.0 identifies the Release B Subsystem Test Cases and includes the following for each test case: test number, test title, applicable software/hardware test configuration, test support data items, test abstract, success criteria, and detailed test procedure steps

Section 6.0 identifies the Release B end-to-end test cases and includes the following for each test case: test number, test title, applicable software/hardware test configuration, test support data items, test abstract, success criteria, and test procedure step outlines.

Appendix A identifies the FOS Datasets needed for FOS testing, and the timeframe of need for each dataset type.

Appendix B identifies the Release B Level 4 Requirements to Test Case matrix.

Appendix C identifies the Test Case to Release B Level 4 Requirements Matrix.

Appendix D identifies RBR to Test Case matrix.

Appendix E identifies the Test Case to RBR Matrix.

Appendix F identifies the Test Configuration Tables.

The section Abbreviations and Acronyms contains an alphabetized list of the definitions for abbreviations and acronyms used in this volume.



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## 2. Related Documentation

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### 2.1 Parent Documents

The parent documents are the documents from which this FOS Integration and Test Plan's scope and content are derived.

|                |  |
|----------------|--|
| 304-CD-001-003 | Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Volume 1: General Requirements   |
| 304-CD-004-003 | Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Volume 2: AM-1 Mission Specific  |
| 423-41-02      | Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System |

### 2.2 Applicable Documents

The following documents are referenced within this document, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this volume.

|                |   |
|----------------|---|
| 307-CD-001-002 | Flight Operations Segment (FOS) Release Plan and Development              |
| 329-CD-001-002 | Plan for the ECS Project  |
| 402-CD-002-002 | System Integration and Test Plan for the ECS Project, Volume 2: Release A |

### 2.3 Information Documents

#### 2.3.1 Information Documents Referenced

The following documents are referenced herein and, amplify or clarify the information presented in this document. These documents are not binding on the content of the FOS Integration and Acceptance Test Procedures for the ECS Project.

|                 |   |
|-----------------|---|
| 194-201-SE1-001 | Systems Engineering Plan for the ECS Project                          |
| 194-202-SE1-001 | Standards and Procedures for the ECS Project                          |
| 193-208-SE1-001 | Methodology for Definition of External Interfaces for the ECS Project |
| 308-CD-001-006  | Software Development Plan for the ECS Project                         |
| 194-401-VE1-002 | Verification Plan for the ECS Project                                 |
| 194-415-VE1-002 | Acceptance Testing Management Plan for the ECS Project                |

|                 |  |
|-----------------|--|
| 501-CD-001-004  | Performance Assurance Implementation Plan for the ECS Project                  |
| 194-502-PA1-001 | Contractor's Practices & Procedures Referenced in the PAIP for the ECS Project |
| 604-CD-001-004  | Operations Concept for the ECS Project, Part 1--ECS Overview                   |
| 604-CD-002-003  | Operations Concept for the ECS Project, Part 2B--Release B                     |
| 604-CD-003-002  | Operations Concept for the ECS Project, Part 2A--Release A                     |

### **2.3.2 Information Documents Not Referenced**

The following documents, although not referenced herein and/or not directly applicable, do amplify or clarify the information presented in this document. These documents are not binding on the content of the FOS Integration and Test Plan for the ECS Project.

|                 |  |
|-----------------|--|
| 104-CD-001-004  | Data Management Plan for the ECS Project       |
| 193-105-MG3-001 | Data Management Procedures for the ECS Project |

## **3. FOS Integration and Test Plan**

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This section contains an overview of the approach taken to ensure complete and thorough testing by the FOS. Included is information concerning the FOS I&T approach, phases, environment, relationships with other test organizations, test schedules, test responsibilities and specific verification activities performed by the FOS Test and support organizations.

### **3.1 FOS Context**

The Earth Observing System Data and Information System (EOSDIS) Core System (ECS) involves the collection and distribution of earth science data from space and ground based measurement systems. The FOS is one of two segments, which when combined with the Science and Communications Development Organization (SCDO) makes up the development portion of the ECS. The FOS provides a set of functions in support of the EOS AM-1 spacecraft and its complement of instruments and includes mission planning and scheduling, spacecraft commanding, instrument command support, health and safety monitoring, data analysis and overall mission operations.

### **3.2 FOS Integration and Test Overview**

The FOS integration effort begins with the allocation of functions to internal builds and releases (e.g. developing the build/thread model), and organizing the phasing of the development effort. In particular, internal and external dependencies are identified, resulting in a logical progression of development activities matching the internal/external dependency needs of FOS and its external interfaces outlined in the build/thread model. During this phase, the FOS Test Team designs its test procedures.

During the Integration Phase of each release, the segment development organization performs unit testing of newly developed and heritage software, as well as those Commercial Off-The-Shelf (COTS) software products incorporated into segment software. As components are integrated at the EDF, they are made available to the FOS Test Team to perform checkout of test procedures.

Following successful completion of the Test Readiness Review (TRR), the software is migrated to the EOS Operations Center (EOC) facility at Goddard Space Flight Center (GSFC) (building 32) and made available for dry-run testing. Following a successful CSR (Consent to Ship Review), the formal test period begins. Formal test activity includes the execution of functional thread tests and end-to-end tests designed to ensure concurrent operational functionality. For Release B the CSR consisted of two parts.

In conjunction with the ECS Acceptance Test Organization (ATO), the FOS Test Team performs formal testing at the EOC (GSFC-building 32). This includes a dry run test period, in which all previously designed test procedures provided in this document are executed against the aggregate set of FOS software. During dry run testing, time is allocated to the Development Organization

for providing necessary software fixes. Following the successful completion of dry-run testing, formal testing begins. During this period, test procedures are executed by the FOS and ATO Test Organizations and is witnessed by cognizant National Aeronautics and Space Administration (NASA) representatives.

Prior to the dry run test period, the Maintenance & Operations (M&O) Organization performs verification of COTS hardware and those COTS software products used in the hardware support environment, such as operating systems. M&O personnel support the efforts of other verification organizations and maintain the operational system by verifying changes during the M&O phase. Additionally, the M&O organization provides a high level of operational support in generating end-to-end test scenarios and provides support during end-to-end test execution.

The Quality Office monitors and witnesses tests and ensures that test procedures are followed and non conformances are correctly documented. The Configuration Management (CM) and Data Management (DM) organizations provide baselined items for accomplishing all levels of testing, and they support configuration audits. The IV&V contractor performs an independent assessment of the functionality and performance of ECS releases.

The Flight Operations Team (FOT) provides support to the test team during the development of test plans and procedures by identifying operational scenario candidates for incorporation into test case scenarios, and identifying data set needs for those tests.

Table 3.2-1 depicts the verification role of each organization during the development and integration and test stages of ECS. The organizations are mapped to the verification levels which correspond to an increase in scope from unit testing of individual modules to final operational testing leading up to launch.

**Table 3.2-1. Primary Verification Roles**

| Organization                  | Development Phase                                     | I&T Phase   |
|-------------------------------|---|---|
| <b>Phase Review Milestone</b> | <b>TRR</b>  | <b>CSR/RRR</b>                                    |
| Software Developers           | Code & Unit Test                                      | Fix Software Bugs                                 |
| Integration Team              | Integration Planning<br>Integration Plans             | Build System<br>Integrate FOS Functions           |
| FOS Test Team                 | Test Planning<br>Monitor Development                  | Dry Run FOS Tests<br>Execute Formal FOS Tests     |
| Quality Office                | Attend Walkthroughs<br>Review Test Plans/Proc.        | Monitor Integration<br>Witness FOS Tests          |
| M&O                           | Planning & Scheduling,<br>Tools, Training             | Provide S/W Libraries<br>Control Test Environment |
| FOT                           | Member of Integration Team<br>Review End-to-end Tests | Member of Integration Team                        |

### **3.3 FOS Integration Approach**

The integration team, comprised of FOS systems engineering, development, and test personnel heads the FOS integration effort. The FOS test team provides support to the integration team.

Upon successful completion of unit testing, software is merged to the subsystem group branch within Clearcase, and a subsystem build is performed. The software is then turned over to the integration team and migrated to the Integration Environment. Executables are copied from the release branch to the /net/beeper/fosb/dev/am1/bin directory for functional integration and interface checkout.

For software that completes unit testing with known problems and is turned over to the integration team, group level, Internal Non-conformance Reports (INCRs) will be entered into the “subsystem projects” of the Distributed Defect Tracking System (DDTS) to track the defects. Software problems/discrepancies that arise during the integration phase will also be tracked via INCRs and entered into the integration project of DDTS.

#### **3.3.1 Test Procedure Walk-through & Checkout**

During development and integration, applicable test procedures are reviewed by subsystem(s) developers, integration, the FOT, system engineering and QA representatives in order to ensure applicability of procedures to system functionality and assure requirements mapping is complete and accurate. The Test Team conducts the procedure walk-through while the development team provides support on an as-needed basis. QA monitors procedure walk-through progress.

As software components are successfully integrated, test procedures are checked against the software components that have been successfully integrated. Procedure checkout against the incremental threads will be conducted from the net/beeper/fosb/int/am1/bin directory. Any problems/discrepancies that arise during procedure checkout are entered into the DDTS as INCRs. The Test Team will conduct procedure check-out while the integration team provides support on an as needed basis. QA will monitor procedure checkout progress.

#### **3.3.2 Preparation for Test Readiness**

Upon successful completion of procedure check-out activities, a software turnover form (STF) is submitted requesting that the aggregate set of software be merged and built at the MAIN level. The STF requests that CM perform a build of the FOS software and executables from the build and that the software be made available for migration to GSFC. Executables are then copied to the EOC facility at GSFC (building 32) for dry run and formal test.. Following migration to GSFC, a brief checkout is made by the Development, Integration and Test Organizations to ensure that the complete set of FOS software is migrated successfully and ready for test. This includes invoking all of the FOS Startup Scripts to ensure no data integrity loss of the FOS Software during the migration process.

## **3.4 FOS Test Approach**

For each FOS internal build and formal release, the FOS Segment Development Organization performs unit testing of newly developed and heritage FOS software. During unit testing, the FOS Test Organization provides a test support role which includes monitoring software integration activity and supporting test execution. Following integration and unit testing, the FOS Test Organization and the ATO verify that the FOS integrated software meets Level 3 requirements as specified in the Functional and Performance Requirements Specification (#423-41-02), and also meets Level 4 requirements as specified in the RTM database

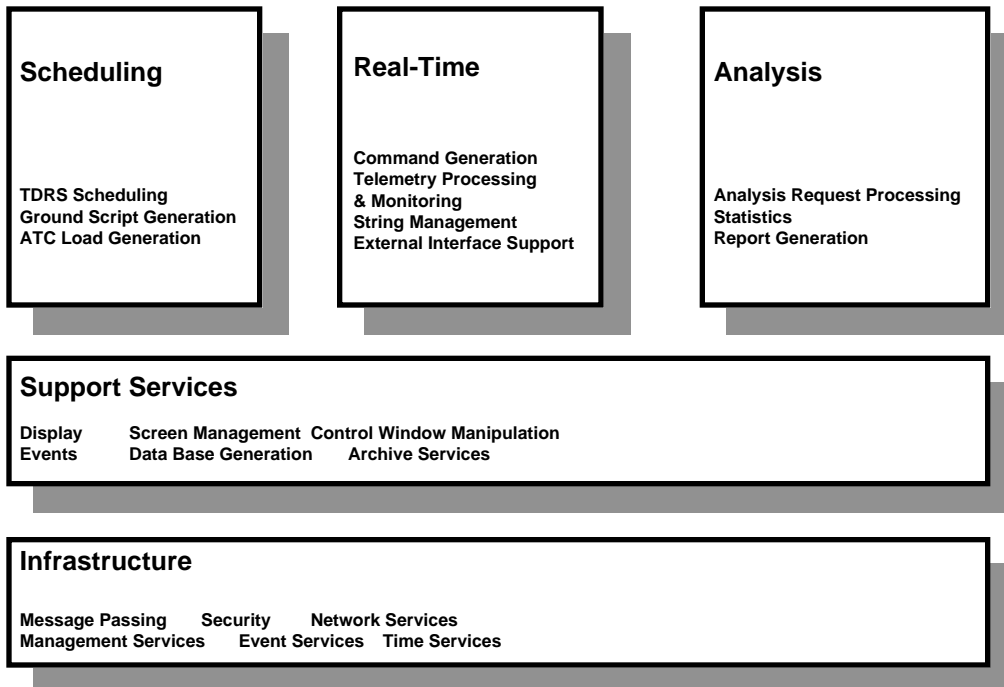
The FOS test approach focuses on three levels of testing. Level 1 testing focuses on the infrastructure testing ensuring the foundation of the system is robust. Level 2 testing emphasizes testing at the FOS subsystem level. Level 3 tests are end-to-end tests which emphasize the testing of the FOS as a whole, where previously tested functionality is exercised concurrently in a controlled test environment. Each test procedure has been identified as a Level 1, 2 or 3.

During the development phase of the project, test cases are designed on the build/thread methodology, where functional software pieces or “threads” are defined along with associated components. As test case development matures, test cases are updated to include associated user scenarios, followed by a strict mapping of Level 3 and Level 4 requirements to those test cases.

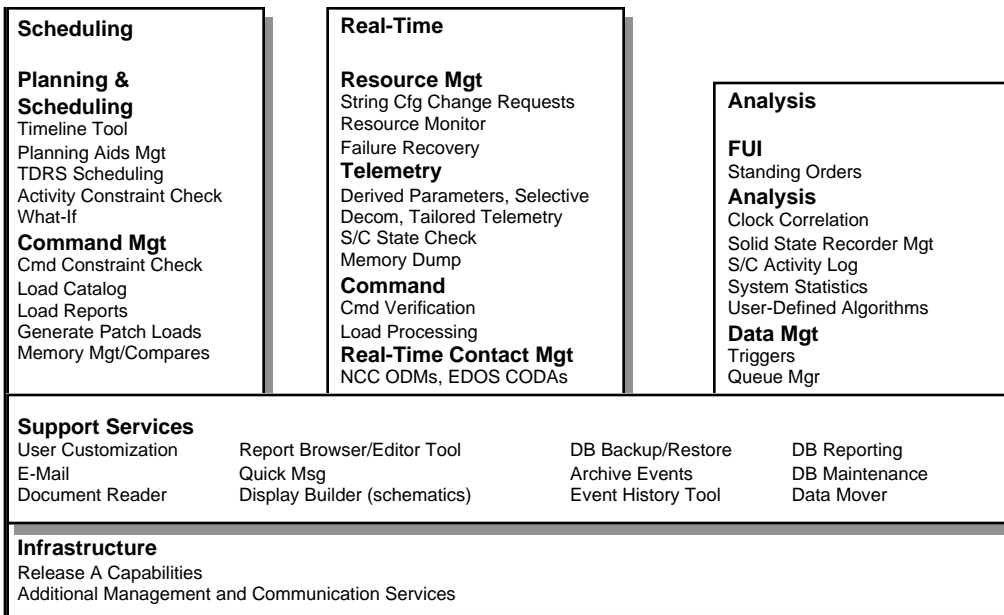
### **3.4.1 FOS Thread/Build**

The thread/build concept, which is based on the incremental aggregation of functions, is used to plan FOS segment test activities. All FOS internal builds and incremental releases are logically grouped into 5 high-level building blocks called phases - Infrastructure, Support Services, Scheduling, Real-time, and Analysis. Figure 3.4.1-1 below provides a high-level breakdown of the FOS functions defined for each phase of development.

## Release A:



## Release B:



**Figure 3.4.1-1. Release A/B Phase Definitions**



### **3.4.2 FOS Test Organization Responsibilities**

The FOS Test Organization roles and responsibilities include the following:

- Develop test plans and test procedures in accordance with the FOS Test Organization's Build/Thread Plan, associated requirements documentation and FOT use case definition
- Accept unit-tested software from the Segment Development organizations.
- Conduct testing of threads and components following internal builds and incremental deliveries.
- Perform end-to-end testing as components are added to system configurations with a focus on internal and external interfaces.
- Conduct intra-segment interface verification.
- Report formal test results.
- Generate non conformance reports.
- Re-verify software fixes resulting from non conformance reports via regression testing.
- Work with the M&O and ESDIS organizations in support of operational ground system testing.
- Work with the IV&V contractor in support of interface tests.

### **3.4.3 FOS Test Phases**

The following sections define FOS test activities performed during the FOS I&T phase.

#### **3.4.3.1 Test Planning Phase**

During the SDR-PDR timeframe, FOS Segment/System Integration & Test Plan (#319/DV1 and #402/VE1) outlines are developed by the FOS Test Organization utilizing high-level operations concepts developed by the Segment Development Organization in conjunction with the FOS build/thread plan and requirements allocation. During the PDR-CDR timeframe, the system/segment test plan descriptions are completed and the FOS Segment/System Integration & Test Plan (# 319/DV1 and #402/VE1) is made available for CCB approval. Also during this time frame, test data drivers, test dependencies, test configuration, and test location support needs are identified by a combined effort of the FOS Segment Development and FOS Test Organizations.

During the CDR-TRR time frame, the FOS Integration and Acceptance Test Procedures document (#322/DV2 and 411/VE1) is developed by the FOS System/Segment Test Organization using the FOS System and Segment Integration & Test Plan (#319/DV1 and #402/VE1) as an outline for test procedures. This document was made available for CCB Approval at TRR.

### **3.4.3.2 Test Execution & Analysis Phase**

Following a successful TRR, Release B is installed at the EOC facility at GSFC (building 32). The formal installation of Release B includes custom code and COTS software, executables, load modules, test data sets, test tools, and documentation. The formal installation at the operational sites is performed by the FOS Integration Team, supported by CMO and the M&O organizations.

Dry run and formal testing is performed at the EOC facility following successful migration of software from the EDF to the EOC. Test activities for Release B, are based on Release B's associated test cases and regression testing of A1/A2 test cases. This philosophy provides a complete comprehensive testing of the entire FOS system. As the FOS system and the knowledge of the system matures, test cases may be reconstructed, merged, added or deleted based on a more current understanding of the system. These updated procedures form the basis for all FOS dry run and formal testing, and become an integral part of the FOS Integration and Acceptance Test Procedures document (#322/DV2 and 411/VE1).

The FOS Test Organization is responsible for test execution, with support from the FOS Segment Development Organization and ATO organization. All FOS segment test activity is performed using the FOS Integration and Acceptance Test Procedures document (#322/DV2 and 411/VE1). Non conformance software reports are written by the segment test engineer, test conductor or designee and delivered to the FOS Segment Development Organization.

All test analysis activity associated with the execution of test procedures (i.e. command data bit-busting, decommutation calculation analysis, etc.) is identified in the FOS Integration and Acceptance Test Procedures Document (#322/DV2 and 411/VE1) on a test by test basis. Analysis methods, analysis results, test data logs, event logs and Non-Conformance Reports (NCRs) written as a result of analysis activity are identified in the FOS Test Report Document (#324/DV3 and 412VE2).

### **3.4.3.3 Test Reporting Phase**

FOS segment test reporting activity is performed by the FOS Test Organization for each formal release. All testing activity performed during the FOS test execution phase is logged by the test engineer and/or test conductor, with support from the NASA Technical Officer or representative, and the QA representative. These test logs (see Figure 3.4.3.3-1 below) along with data analysis results performed during the test analysis phase are used by the FOS Test Organization in developing the FOS Test Report Document (#324/DV3 and 412/VE2). These logs reside in the controlled EDHS Project Forms Area. Reporting information includes the results of each test, deviations from the test procedures, data analysis methods and results, and NCRs identification.

|                          |            |                       |         |
|--------------------------|------------|-----------------------|---------|
| Sequence:                |            |                       |         |
| Test Procedure Name:     |            |                       |         |
| Test Procedure ID:       |            |                       |         |
|                          |            |                       |         |
| Test Location:           | Site:      |                       |         |
| S/W Config./ Version:    |            |                       |         |
| H/W Config./ Host Names: |            |                       |         |
| Test Data:               |            |                       |         |
| Test Tools/ Scripts:     |            |                       |         |
| Test Date:               |            |                       |         |
| Witness(es):             |            |                       |         |
| Comments:                | Test Time: |                       |         |
|                          |            |                       |         |
|                          |            |                       |         |
|                          |            |                       |         |
|                          |            |                       |         |
| NCRs Written:            |            |                       |         |
| NCRs Verified:           |            |                       |         |
| NCRs Un-Verified:        |            |                       |         |
| Pass                     | Fail       | Partial Pass/Fail     |         |
| 1st Run                  | Formal Run | Retest                | Release |
| Tester Signature(s)      |            | Witness Signature(s): |         |
| _____                    |            | _____                 |         |
| _____                    |            | _____                 |         |
| _____                    |            | _____                 |         |

**Figure 3.4.3.3-1. Test Log Form**

### 3.4.4 FOS Test Roles and Responsibilities

The following FOS Test personnel shall be responsible for the execution of FOS tests in the following manner:

Test Engineer - The FOS segment test engineer, or appointed representative shall be responsible for the generation and publication of all FOS test plans and procedures.

Test Conductor - The FOS test conductor, or appointed representative is responsible for establishing test configuration and ensuring test prerequisites are satisfied. The test conductor is also responsible for scheduling and coordinating the time and resources needed for specific tests, rescheduling tests following test failure, collecting test outputs

and test logs, writing NCRs, and recording test results. The test conductor is also responsible for writing the segment test report following test completion.

**Test Participants** - The FOS Segment Development Organization may assist the test conductor/engineer(s) in the performance of the test procedures. Other supporting organizations may include ATO, Maintenance and Operations (M&O) and Configuration and Data Management (CM). M&O will be responsible for reconfiguring the system as needed to control testing; CM will provide a controlled environment for the storing and maintaining of information about the test environment including hardware, software and test tool environments.

**Test Witnesses** - Individuals invited to directly observe test conduct. This may include members from the M&O, or ESDIS organizations.

**Quality Assurance** - During the segment test planning phase, the QA organization reviews the FOS I&T Plan for the traceability of FOS level 4 and level 3 requirements to the planned test cases. During the test procedure generation phase, QA reviews test procedures for test and requirements consistency between the FOS I&T Plan and FOS I&T Procedures. During the formal segment test execution phase, QA verifies the configuration of the software prior to the performance of the tests. QA also witnesses the tests to monitor that procedures are tested as written, and that problems and deviations are noted. During the test analysis and reporting phase, QA reviews the test report for accuracy and verifies that NCRs are written for all validated problems and entered into the non conformance tracking system.

### **3.4.5 Verification Methods**

The four verification methods used during the FOS segment test period include inspection, analysis, demonstration, and test as defined below:

- **Inspection** - The visual, manual examination of the verification item and comparison to the applicable requirement or other compliance documentation, such as engineering drawings.
- **Analysis** - Technical or mathematical evaluation based on calculation, interpolation, or other analytical methods.
- **Demonstration** - Observation of the functional operation of the verification item in a controlled environment to yield qualitative results without the use of elaborate instrumentation, procedure, or special test equipment.
- **Test** - A procedure or action taken to determine under real or simulated conditions the capabilities, limitations, characteristics, effectiveness, reliability, or suitability of a material, device, system, or method.

Each requirement is verified by one or more of these methods. Verification method(s) are specified in the ECS Verification Plan (#194-401-VE1-002).

## 3.5 Test Resources

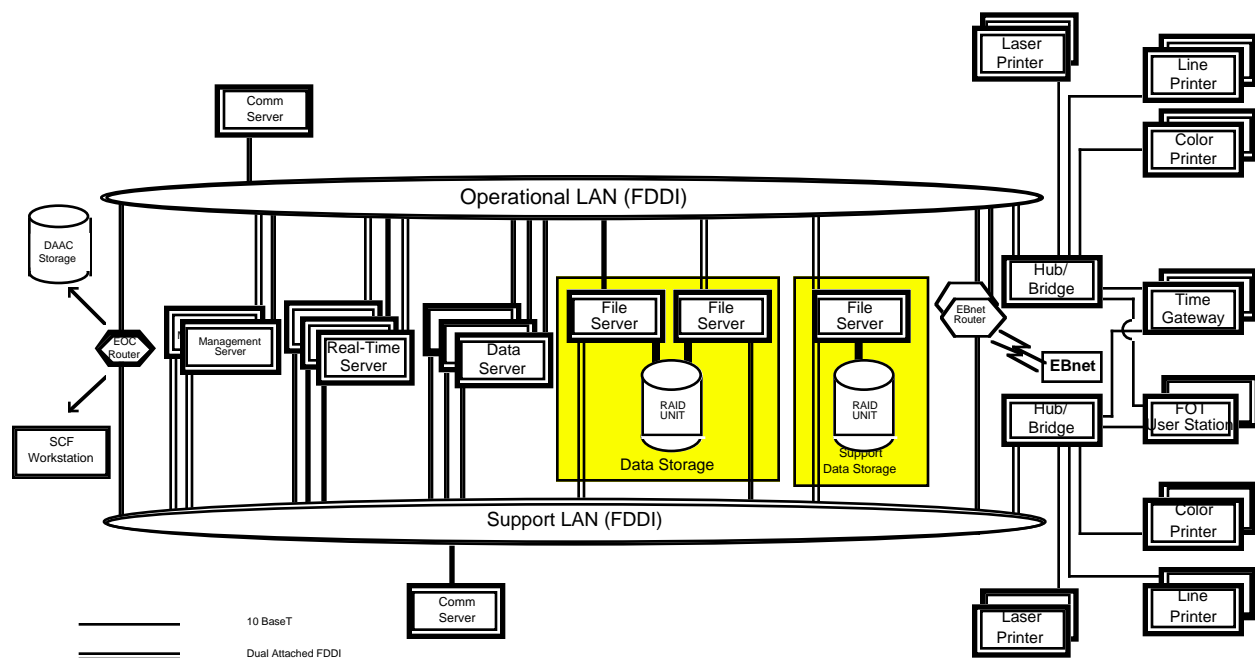
The following paragraphs in this section identify and describe the resources necessary to accomplish FOS testing. Included are identification of test facilities and hardware configurations.

### 3.5.1 Testing Facilities

The ECS Development Facility (EDF) located at the ECS facility in Upper Marlboro, Md. and the EOC facility at GSFC (building 32) are both utilized by the FOS Test Organization. Test procedure checkout, and early testing is performed in the EDF for integrated FOS software components. Following a successful TRR, the developed software is migrated to the GSFC EOC Facility (building 32). Following software installation at the EOC, dry run and formal testing is performed by the FOS Test Team with support from the ATO organization.

### 3.5.2 Hardware Configuration

Figure 3.5.2-1 below provides the basic FOS hardware configuration used in support of FOS Test at the EDF and at the EOC. Additionally, for test cases requiring additional hardware not shown in the figure, specific hardware is listed under the associated test case's "Test Support" heading as described in this FOS Integration and Acceptance Test Procedures Document (#322/DV2 and 411/VE1 ).



**Figure 3.5.2-1. FOS Test Configuration**

### 3.6 Test Data & Test Data Sources

In support of FOS Release A segment testing the following test data sources have been identified:

- EOSDIS Test System (ETS): The ETS will be used in the Release B timeframe for the transfer of “test” telemetry and spacecraft recorder data to the EOC by emulating EDOS or the AM-1 spacecraft. It will also be used for the transfer and acceptance of AM-1 spacecraft and instrument commands.
- Software Data Drivers: Provided in-house, data drivers will be provided by the FOS Development and Test Organizations when specific test data/interface simulation is not available via any other source. The aggregate set of data drivers will reside on a designated test user station which is accessed and controlled by the FOS Test Organization (see Appendix A for the aggregate set of test datasets). Software drivers utilized for the Release A timeframe include:
  - NCC GCMR acknowledgment/disposition message generator
  - Test Data Generator for real-time telemetry streams
  - Real-time Event Message Generator
  - CODA Generator
  - CLCW Generator
  - SCS Summary Report

### 3.7 Test Tools

The FOS Development and Test Organizations utilize the following ECS selected COTS tools in support of the test effort:

- Requirements and Traceability Management Tool (RTM) - CASE tool which provides the means for creating, populating, and maintaining a data base containing requirements, verification, and design information. RTM provides the means for mapping Level 4 and Level 3 requirements to FOS test cases.
- ClearCase Configuration Management Tool - CM tool used to support configuration management for developing, testing and maintaining software.
- Distributed Defect Tracking System (DDTS) - discrepancy tracking tool used to record, track and report non conformances encountered during a test session.
- tcpdump utility - prints out the headers of packets on a network interface

### **3.8 Regression Testing**

Regression testing (i.e. supplemental testing performed to ensure that existing software is not adversely affected by newly integrated software components) is performed following patch deliveries. As a general rule, the regression test case ETE-2010B, designed to test critical functions from all nine FOS subsystems is performed during the regression test period, followed by selected test cases chosen by the test team. Cases chosen for regression test activity are those existing test cases which encompass the most functional paths related to software components modified as part of the patch. During the I&T phase, the FOS Test Organization, with the coordination of FOS development, system engineering and QA organizations is responsible for choosing the suite of tests performed for regression to ensure the chosen test suite provides adequate coverage of affected software. Regression test results for “patch” deliveries are documented in test reports delivered to NASA no later than one month following the completion of testing. In addition regression testing of Release B will also include verifying all outstanding Discrepancy reports from Release A.

### **3.9 Discrepancy Reporting and Resolution**

The Non conformance Reporting and Corrective Action (NRCA) system is the process for identifying, investigating, and resolving problems with the ECS during development, integration, installation, and formal test. To facilitate disposition and resolution of problems, the NRCA system and its processes emphasize tracking of responsibility, effective communication and delegation of authority. The NRCA system utilizes the DDTS to record and track software non conformances. DDTS is customized by ECS to accurately reflect the progress of Non conformance Reports (NCRs) through resolution and captures necessary information to document that progress. Through the production of management reports, DDTS provides management visibility and metrics to insure that NCRs are being worked in a timely and effective manner.

During the execution and analysis phases of testing, all non conformance reports (NCRs) are written by the test engineer, test conductor, NASA Technical Officer/representative, or the QA representative.

The FOS Test organization uses the DDTS non conformance tracking and reporting software tool for tracking non conformances. Individual NCR information tracked includes the date the NCR was received, the subsystem the NCR is written against, the priority of the NCR, current resolution status of the NCR, and problem description.

### **3.10 FOS Integration and Test Schedule Overview**

Table 3.10-1 identifies all tests and FOS integration milestones. The table includes both FOS internal milestones and ground tests planned by the ESDIS organization which require support from the FOS. The purpose of this table is to delineate the functionality required by the FOS to support these tests and to emphasize internal dependency milestone dates in which the FOS needs to have integrated this functionality.

**Table 3.10-1. FOS Composite Test Schedule (Page 1 of 3)**

| <b>TIME FROM LAUNCH (Months)</b> | <b>TEST NAME</b>                           | <b>TEST DATES</b>   | <b>TEST DESCRIPTION</b>  | <b>FOS REQUIREMENTS</b>   |
|----------------------------------|--|---------------------|--|---|
| Launch (L)                       |  |                     |  |   |
| L-22 Months                      | ASTER ICC Data Flow Test                   | 9/5/96 - 9/10/96    | ASTER access to EOC Planning & Scheduling information  | ASTER-ICC land lines to the EDF operational; or ASTER ICC at EDF  |
| L-20                             | IST 2-Way Data Flow Test                   | 11/25/96 - 11/28/96 | Basic EOC/IST communications; IST access to EOC Planning & Scheduling data.                              | Support Planning & Scheduling data flows of timelines and activities; Partial IST toolkits.   |
| L-19                             | AM-1 spacecraft Bus Comp. Performance Test | 12/6/96 - 12/20/96  |  | EDOS/ETS IF; EBnet I/F; FOS User Interface (FUI), ODBs to support R/T TLM & SCC dump processing at EOC, ISTs , R/T telemetry processing and display, command procedures and script execution. |
| L-18                             | EOC Compat. Test #1                        | 1/14/97- 1/17/97    | TBD  | TBD   |
| L-16                             | Comp. Performance Test #1                  | 3/20/97 - 3/24/97   | Spacecraft housekeeping tlm processing by the EOC; spacecraft and instrument dump processing by the EOC. | All forward and return links in the RF ICD; FUI   |
| L-15                             | Command Management Test                    | 4/8/97 - 4/11/97    | CMD Load built at EOC. CMD verification following transmission to ETS/EDOS                               | R/T command uplink at all supported rates to either ETS or EDOS, depending on EDOS availability.  |
| L-15                             | AM-1 Spacecraft RF Compat. Test            | 4/15/97 - 5/15/97   | Multiple tests with TDRSS; demonstrate RF compatibility  | All forward and return links in the RF ICD; FUI.<br>TDRSS scheduling through NCC interface.   |



**Table 3.10-1. FOS Composite Test Schedule (Page 2 of 3)**

| TIME FROM LAUNCH | TEST NAME                           | TEST DATES          | TEST DESCRIPTION   | FOS REQUIREMENTS  |
|------------------|-------------------------------------|---------------------|--|---|
| L-13             | IST 2-Way Data Flow                 | 6/2/97 - 6/6/97     |  | Tailored telemetry processing at IST, receipt of command requests from IST; IST Toolkits, FUI   |
| L-12             | Mission SIM Readiness Test          | 7/7/97 - 7/11/97    | Verify functional capability of s/c data base, perform spacecraft maneuvers, mission simulations.  | All forward and return links required for support. real-time and contingency commanding. Not intended for verification of ground system.  |
| L-12             | EOC Compat. Test # 2                | 7/15/97 - 7/18/97   | CMD RATES: 125 BPS, KBPS, 2KBPS, 10 KBPS. TLM Rates: 1/1, 16/16, 16/256, 16/516 KBPS R/T SCC Data, SSR Buffer Dump. EOC, EDOS, EBnet, WSGT, TDRSS support. | All forward and return links in the RF ICD; Comprehensive EOS Command and Telemetry demo. Test completed between L-13 months and L-3 months; completed prior to spacecraft end to end test. |
| L-11             | AM-1 Spacecraft Thermal Vacuum Test | 8/20/97 - 9/15/97   | Activate S/C and instruments in vacuum; acquire live instrument data   | real-time processing of TLM at rates: 1/1, 16/16, 16/256, 16/516 kbps. EOC sends commands to AM-1.  |
| L-8              | Comp. Performance Test #2           | 11/15/97 - 11/19/97 | AM-1 sends R/T and SCC dump & HK TLM to SN; EDOS/DIF send data to EOC  | Process all real-time data at all rates; process SCC dumps.   |
| L-7              | EDOS/ETS/EBnet                      | 12/15/97 - 2/10/97  | Real-time and Contingency Commanding; real-time telemetry receipt; dump data receipt   | command uplink at all supported rates; real-time telemetry receipt - all formats at all supported data rates. Dump receipt at 256/512 kbps.   |
| L-6              | EOC Compat. Test # 3                | 1/2/98 - 1/6/98     | Demonstrate S/C compatibility to EOC command & TLM database  | EOC use of validated command, telemetry, activity and constraint database.  |

**Table 3.10-1. FOS Composite Test Schedule (Page 3 of 3)**

| <b>TIME FROM LAUNCH</b> | <b>TEST NAME</b>                | <b>TEST DATES</b> | <b>TEST DESCRIPTION</b>  | <b>FOS REQUIREMENTS</b>  |
|-------------------------|---------------------------------|-------------------|--|--|
| L-4                     | AM-1 End-to End Test            | 3/3/98 - 3/8/98   | Demonstrate integrated S/C and ground system compatibility   | All forward and return links required for support; EOC sends commands and SCC & SI microprocessor loads; send commands |
| L-4                     | Mission OPS Simulation          | 3/9/98 - 3/20/98  | Validate subset of nominal, contingency mission OPS procedures   | 100 hours of scheduling operations including contingency situations.   |
| L-2                     | Comp. Performance Test #3       | 5/13/98- 5/17/98  | AM-1 send H/K TLM to EOC and EDOS via GSE & SN . EOC sends commands to AM-1 at VAFB via SN & GSE.                    | Real-time and SSR data processing. R/T command uplink at all supported rates via SN & GSE.                             |
| L-2                     | Ground Data System Test         | 5/18/98 - 5/31/98 | All Command interfaces checked. All Scheduling Functions and interfaces checked. All S/C Data and Types checked.     | All forward and return links required for support at VAFB. Includes DSN, GN & WOTS.                                    |
| L-1                     | AM-1 Launch Site Readiness Test | 6/2/98 - 6/5/98   | SCS Provides data from VAFB to EDOS. EDOS sends Data to EOC. EOC sends attitude data to FDF & CMDS to VAFB via EDOS. | All forward and return links required for support at VAFB.   |
| LAUNCH                  |                                 | 6/30/98           |  |  |

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